5

Tag Effects Considerations in Electronic Tagging Studies

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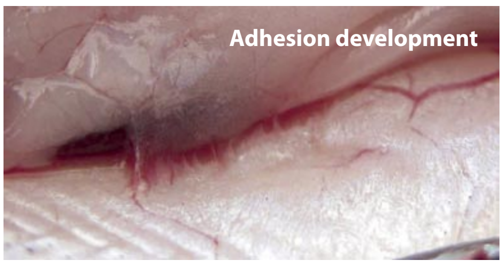
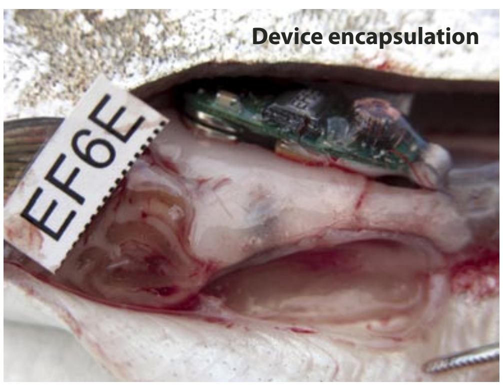
Advances in the development of electronic tagging technology have resulted in a proliferation of applications for providing data directed at specific fisheries management goals. The preponderance of electronic tagging techniques involves implanting or attaching a device to the subject. Both cases involve invasive procedures, and since even the use of anesthetic can alter body chemistry, use of these devices can be both behaviorally and physiologically disruptive, resulting in uncharacteristic performance of tagged individuals relative to the untagged population. Tag effects studies can be conducted to characterize the extent of divergence from a control condition. For the most part these have been laboratory studies involving immediate influence on growth and survival over the life of the electronic instrument. This abstract suggests that tag effects considerations should be revisited periodically in the laboratory and in the field.

The term "laboratory studies" is used here to describe work to appraise the effects of tagging where otherwise free-ranging animals are held captive. This process can fall into several categories, including intermediate-term studies for animals held in raceways, net pens, or tanks for extended periods, as well as retention groups held for short-term assessment. Longer-term efforts are generally designed to evaluate some aspect of physiological or behavioral response of a tagged group relative to a reference (control) group of similar animals, while retention groups are often used to make relatively shorter duration inferences about a simultaneously tagged and released cohort.

Assuming that captive animal response is similar to what the subject will experience in a natural condition, there are good reasons to implement lab or retention studies. Relative comparisons of growth, survival, pathology, anatomical effects, behavior, and predation are strengths of this approach. For example, observations of tag rejection (shedding or expulsion) and wound healing development (encapsulation, adhesion progression, altered or eroded organs, and so on) are most easily and economically accomplished using captive animals, as are initial comparisons among tag devices, coating or potting types, or form factors (Figures 1 and 2). Lab studies can also be important where a surrogate species may be used to refine a device or procedure for a protected target species.





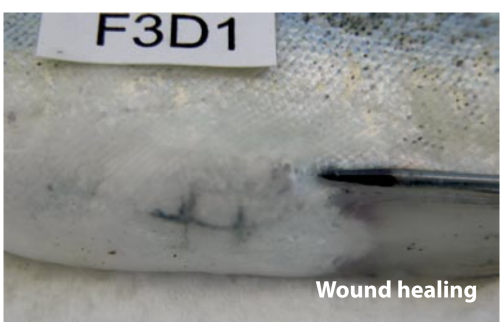


Figure 1. Tests were conducted to determine how salmonids responded to being tagged with microacoustic tags. As depicted, common salmonid responses exhibited during the tag-retention study include adhesion development, device encapsulation, and wound healing.

It seems obvious that feasibility studies must be undertaken with captive animals to assess immediate effects of a new tag on the target organism before full-blown field studies are attempted. However, it is also advisable to revisit key aspects of the original evaluation during the field study using retention groups. Holding a portion of the released group in as near ambient conditions as possible can afford insight into perturbations resulting from changes in conditions over the tagging season.

There are two outstanding limitations to using the laboratory approach. The most obvious is that the captive cohort is shielded from synergistic physical and biological influences that it would normally be subjected to in a natural system. The second weakness is that prolonged captivity may be at least as traumatic as the tagging procedure, particularly in the longer term.

Both of these limitations can be at least partially overcome by developing procedures for evaluating postrelease tag effects. Given the increasing importance of electronic tagging, it would be advisable to begin to build tag effects objectives into the study design. One

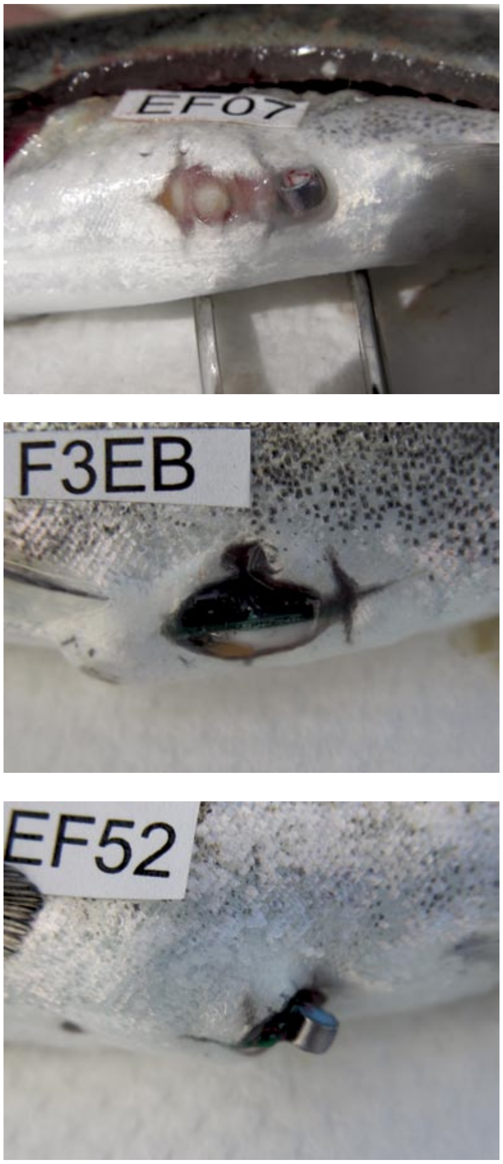


Figure 2. During the tag-retention study, some of the fish rejected the prototype tags.

way this can be done is to compare developmental and established tagging methods to create a tag effects index. For example, this technique has recently been applied during survival studies of acoustically tagged steelhead (*Oncorhynchus mykiss*) in the Columbia River. Groups of fish tagged with acoustic and passive integrated transponder (PIT) tags were released simultaneously with groups of steelhead with PIT tags only. Comparison of the percentages of PIT tag recoveries from bird droppings will be used as an index to tag effects for acoustically tagged individuals. A similar method could be designed to specifically compare tag effects among electronic tags with different characteristics (shape, size, coating type, and so on) under field conditions.

Finally, a discussion of electronic tagging effects must include an examination of ethical considerations for the tagged subject. The debate should inform deliberation relating proper tagging protocols, relevance of the research to the target species, and the long-term fate of the tagged subject. One area of this debate involves surgical procedures. Researchers are increasingly using surgical techniques to implant transmitters, in part due to evidence that adverse effects of surgical implants decrease over time. Surgical procedures require training and practice for proficiency, and surgical and handling techniques should also be reviewed periodically to include new developments. The ultimate ethical purpose of a tagging effort should be to reduce tag-related effects to the point where tagged individuals survive to reproduce at the same rate as untagged animals.